J Community Health
DOI 10.1007/s10900-011-9496-x

ORIGINAL PAPER

Diabetes Self-Efficacy Strongly Influences Actual Control of Diabetes in Patients Attending a Tertiary Hospital in India

Kavita Venkataraman · Anjur Tupil Kannan · Om Prakash Kalra · Jasvinder Kaur Gambhir · Arun Kumar Sharma · K. R. Sundaram · V. Mohan

Abstract A cross-sectional survey of 507 in- and out-patients, with diagnosed Type 2 diabetes mellitus (T2DM) was undertaken to study the relationships between personal, disease and treatment-related factors and diabetes control in a tertiary care hospital. On multivariate logistic regression analysis, self-efficacy (odds ratio (OR) = 2.94; 95% confidence interval (CI) = 1.92–4.54; $P < 0.001$) was the single most important determinant of current diabetes control (HbA1c $\leq$ 7%), along with absence of hyperglycemic symptoms in the past year (OR = 1.83; 95% CI = 1.15–2.93, $P < 0.01$), current treatment with oral medication (OR = 1.77; 95% CI = 1.17–2.66; $P < 0.007$), and adherence to dietary restrictions (OR = 2.7; 95% CI = 1.28–5.88; $P < 0.009$). Self-efficacy was itself influenced by educational status, employment, availability of family support, and positive mental attitudes. Our findings suggest that health care delivery inputs, patients' personal characteristics including education and attitude, and family support for care are complexly processed to determine patients' ability to manage their disease, which ultimately influences disease outcomes.

Keywords Diabetes mellitus · Glycemic control · Health management · India · Self-efficacy

K. Venkataraman (✉)
Department of Obstetrics and Gynaecology, Yong Loo Lin School of Medicine, National University of Singapore, Singapore 119228, Singapore
e-mail: obgkv@nus.edu.sg

A. T. Kannan · A. K. Sharma
Department of Community Medicine, University College of Medical Sciences and Guru Tegh Bahadur Hospital, Delhi 110095, India

O. P. Kalra
Department of Medicine, University College of Medical Sciences and Guru Tegh Bahadur Hospital, Delhi 110095, India

J. K. Gambhir
Department of Biochemistry, University College of Medical Sciences and Guru Tegh Bahadur Hospital, Delhi 110095, India

K. R. Sundaram
Department of Biostatistics, Amrita Institute of Medical Sciences and Research Centre, Kochi, Kerala, India

V. Mohan
Dr Mohan's Diabetes Specialties Centre and Madras Diabetes Research Foundation Chennai, Chennai, Tamilnadu, India

Introduction

Diabetes mellitus is emerging as a disease of public health importance in India with an estimated 50.76 million patients, of the global burden of 285 million, living in India in 2010. In the same year, diabetes will be responsible for one million deaths and a health expenditure of 7.8 million International dollars. This number is expected to increase to 87 million by 2030 [16].

The substantial burden of Type 2 diabetes mellitus (T2DM) in India, with its associated complications and the complexity in management, calls for heightened responsiveness from the health care system to tackle this problem effectively. Available literature suggests that the management of diabetes in India is sub-optimal for the majority of patients. Only 40–50% of individuals achieve the target for glycemic control, while lower numbers achieve targets for blood pressure and lipid control [5, 28, 33, 34, 40].

Along with primary prevention of the disease, appropriate interventions are needed for prevention of complications in those already diagnosed with the disease. Studies from other

Published online: 03 November 2011

countries have identified several provider and patient-related factors which can influence outcome measures in people with diabetes [4, 12, 21, 23, 29]. In particular, several studies have identified self-efficacy, the belief in one's capabilities in a given situation or challenge, as an important factor in successful management of many chronic diseases, including diabetes [3, 14, 22, 38, 43]. It has also been demonstrated that improving patients' knowledge and skills results in better self-management and control of disease through effects on self-efficacy [1, 19, 31]. Better understanding of these aspects in the Indian context can provide leads for organizing health care services, so as to improve disease management and patient outcomes. Hence we conducted this study with the aim of understanding the relationship between diabetes control, as measured by glycated hemoglobin (HbA1c), and socio-demographic, disease, treatment and patient-related factors with special reference to the relationship between self-efficacy and glycemic control.

Methods

The study was designed as a cross-sectional survey of patients with T2DM attending Guru Tegh Bahadur (GTB) hospital, a tertiary level hospital in Delhi, India, for the assessment of glycemic control and its determinants. Adult patients, of both sexes, with diagnosed T2DM on treatment for at least 6 months, attending GTB hospital, as out-patients and in-patients, were recruited from March till December 2006. Informed consent was obtained from all patients prior to inclusion in the study. Severely ill patients and those refusing consent were excluded. Of the 530 patients recruited in the study, seven did not fulfil inclusion criteria, two had incomplete interviews, and 14 did not have HbA1c values. Therefore, data from 507 participants was used for analysis.

Parameters Assessed

Dependent variable—glycemic control measured by HbA1c

Independent variables

1. Socio-demographic—gender; age; marital status; annual household income; religion; number of family members; literacy status; occupation; source of treatment funding.
2. Disease details—current hospitalization status; disease duration; symptoms at diagnosis; initial presentation; presence or absence of eye, kidney, foot, heart problems, hypertension; hospitalization in the last year; episodes of hypoglycemia or hyperglycemia in the last year; blood pressure (BP) at the time of interview.
3. Treatment details—treatment duration; type of provider who made initial diagnosis; hospital where first seen; current treatment; advice for foot care, diet and physical activity; advice to check for eye, kidney, foot, heart problems.
4. Personal characteristics—use of tobacco and alcohol; diabetes knowledge; knowledge of diabetes complications; understanding of diabetes care; attitude towards diabetes; self-perception of diabetes control; adherence to medical advice for meal plan, exercise, medication and testing for eye, kidney, foot, heart problems; family support for diet, medication, physical activity, foot care and blood glucose testing; psychological profile; body mass index (BMI); waist circumference.

A detailed interview schedule was developed specifically for this study, incorporating the diabetes education, understanding, support, and attitude towards diabetes subscales of the Diabetes Care Profile (Michigan Training and Research Centre) [9]. The General Health Questionnaire-12 (GHQ-12) was incorporated into the interview schedule for assessing the psychological profile of patients. The GHQ has been validated as a measure of current mental health in Indian settings [17]. The interview schedule was pilot tested for its validity and acceptability before beginning formal data collection.

Weight was measured using a calibrated spring weighing scale (sensitivity 1 kg), height using a walled tape strip (sensitivity 0.1 cm), waist circumference at the midpoint of the inferior margin of the last rib and the iliac crest using a metre tape (sensitivity 0.1 cm) and blood pressure using a manual sphygmomanometer (sensitivity 2 mm Hg). Weight, height and waist circumference were taken with light clothing, without shoes.

Biochemical Analysis

Blood sample was collected from each interviewed patient for the estimation of HbA1c. One ml of fresh blood was collected in EDTA coated vials, and stored in the refrigerator at 2–8°C. All samples were analyzed within 1 week of collection. HbA1c was estimated through the ion exchange resin method using glycosylated hemoglobin (GHb) kits procured from Coral Clinical Systems, India.

Sample Size Considerations

Previous studies from within and outside India show that 24–50% of patients achieve glycemic control [10, 20, 24, 28, 33, 35]. Using the lowest estimate of 24%, it was calculated that a minimum of 281 patients would be required to accurately assess the proportion achieving control, at an α of 0.05 and 95% confidence interval.

Data Analysis

Data for 507 individuals was included for this analysis. Descriptive analysis was used to study baseline characteristics. Chi square tests and odds ratios were used to explore associations between variables. Two separate multivariate regression models were run, with measured glycemic control, and self-management ability as dependent variables. The regression models used forward logistic regression to identify factors associated with actual diabetes control, and with perceived ability to manage diabetes. All analysis was conducted using SPSS (Statistical Package for Social Sciences, Version 10).

Definitions Used

Type 2 Diabetes Mellitus

As defined by WHO [41], diagnosed by

1. Fasting plasma glucose >126 mg/dl with symptoms, or
2. Fasting plasma glucose >126 mg/dl and 2 h plasma glucose (post 75 gm glucose load) >200 mg/dl.

Glycemic Control

A patient was deemed to be in good glycemic control when the estimated HbA1c value was less than or equal to 7% [15]. All patients with an estimated value above 7% were classified as being in poor control.

Self-Efficacy

Self-efficacy was evaluated using the care ability component of the Attitudes towards diabetes sub-scale. Patients were asked if they were able to do all the things that were needed to keep their diabetes under control through a series of four questions asking whether they were able to—Keep sugar in good control, Keep weight under control, Do the things needed for diabetes, Handle feelings about diabetes. Each affirmative response was assigned one mark, and each response in the negative zero marks. The total score was derived by dividing the sum by four. Those with a total score of two or less and more than two were designated to have poor and good self-efficacy with respect to diabetes management, respectively [36].

Psychological Status

The psychological profile of patients was assessed through the GHQ-12. This is a series of 12 questions, scored from zero (positive frame of mind) to three (extremely negative state of mind). The total score range was zero to thirty six. Scores were categorized as no psychological distress (<15), and psychological distress (≥15) [17].

Body Mass Index (BMI)

The body mass index was calculated as being equal to the measured weight in kilograms divided by the square of the measured height in metres (kg/m^2). The calculated BMI was categorised based on the WHO expert consultation recommendations, into below normal (<18), normal (18–22.99), high normal (23–24.99), overweight (25–29.99) and obese (30 and above) [2].

Abdominal Obesity

Waist circumference was used to estimate abdominal obesity. Cut-offs for waist circumference were determined separately for men and women, based on the international classification [42] and previous research indicating lower cut-offs for Asian Indians [27]. The categories were <90 cm (normal), 90–99 cm (high normal) and >100 cm (obese) for men, and <80 cm (normal), 80–89 cm (high normal) and >90 cm (obese) for women.

Blood Pressure

Recorded blood pressure was classified on the basis of the recommendations of the VIIth Joint National Committee on prevention, detection, evaluation and treatment of high blood pressure (JNC VII) [6].

Results

Background Characteristics

Completed questionnaires and HbA1c reports were available for a total of 507 patients, of which 325 were interviewed as out-patients, and 182 as in-patients. Mean age of interviewed patients was 54 years, and 44.6% (226) were males. 61% (310) reported an annual household income of less than Rs. 50,000. Table 1 shows key characteristics of the subjects interviewed.

The mean duration of disease was 6.5 years, with a range of 0.6–40 years. The initial diagnosis of T2DM among these patients was by private providers in 271 patients (54%), and in a government hospital for the rest. Those diagnosed by private practitioners were more likely to report having manifest diabetic symptoms at the time of diagnosis ($P = 0.05$). Almost two-third (61.1%, 310) of patients had co-existing hypertension. Other commonly reported co-morbidities were eye problems (74.8%, 379), heart problems (29.8%, 151) and kidney problems (17.9%, 91).

Table 1 Background characteristics of study participants

S. No	Characteristic	Percentage of respondents ($N = 507$)
Socio-demographic		
1	Mean age	54 years (±11)
2	Male	45 (226)
3	Married	86 (436)
4	Hindu	77 (390)
5	Illiterate	36 (184)
6	Employed	33 (169)
7	Annual household income < Rs 50,000	61 (310)
8	Tobacco ever use	37 (189)
Disease related		
9	Mean duration of diabetes	6.5 years (±5.9)
10	Hospitalization in the previous year	51.1 (259)
11	Episode(s) of symptomatic hypoglycemia last year	22.7 (115)
12	Episode(s) of symptomatic hyperglycemia last year	25.8 (131)
13	Self reported co-morbidities	
	Eye problem	74.8 (379)
	Hypertension	61.1 (310)
	Heart problem	29.8 (151)
	Kidney problem	17.9 (91)
Treatment related		
14	Currently on anti-diabetic medication (oral/injectible)	89.4 (453)
15	Medical advice for diet modification	97 (492)
16	Medical advice for physical activity/exercise	87.4 (443)
17	Medical advice for foot care	43.8 (222)
18	Medical advice for testing for complications at least once	
	Eye problem	71.8 (364)
	Heart problem	64.7 (328)
	Kidney problem	45.4 (230)
	Foot problem	9.5 (48)

Diabetes Management

All patients were on treatment at the time of interview, either lifestyle modifications alone, or medication with lifestyle modifications. In spite of being on treatment, 25.8% (131) had experienced symptomatic episodes of hyperglycemia over the past year. Those with T2DM of 10 years or more were 3 times (95% CI 1.8–5.1, $P < 0.05$) more likely to have experienced hyperglycemia than those with T2DM of 3 years or less. The odds of these patients being in poor control at the time of interview as well was 2.27 (95% CI 1.47–3.51, $P < 0.001$).

97% (492) and 87% (443) of patients reported having been advised for dietary modification and physical activity by their physicians. In contrast, only 44% (222) of patients had received advice about foot care. There appeared to be no regular mechanism for screening for complications, with 28% (143), 35% (179) and 55% (277) of patients having never been asked to check for eye, heart, kidney problems, respectively. Those who had completed school or above were more likely to have been screened for kidney problems ($P = 0.026$), foot problems ($P = 0.008$), and heart problems ($P = 0.015$), compared to those with lower levels of education. Similarly, those with higher annual household income were twice as likely to have undergone screening for kidney problems ($P < 0.001$). Patients with diagnosed co-existing complications were more likely to have received advice for check ups, though it was not clear whether the advice preceded diagnosis of the complication or vice versa.

All patients reported testing for blood sugar at various intervals, 11.4% (58) once in 6 months or less frequently, 28% (142) once in 3 months, 54.3% (275) monthly and 6.3% (32) more frequently. There was no emphasis on long term monitoring of glycemic control using HbA1c. Only four patients out of 507 had undergone a test for HbA1c.

Control of diabetes and associated co-morbid conditions is shown in Table 2. 210 (41.4%) were in good glycemic control (HbA1c 7% or less). 123 (24%) had HbA1c values between 7 and 8%, and 174 (34%) had values above 8%. 180 (35.5%) patients were in the recommended BMI range of 20–23 kg/m^2. 135 (27%) patients interviewed were overweight (BMI > 25 kg/m^2) and 59 (12%) obese (BMI > 30 kg/m^2). 271 (53%) had normal BMI (18–25 kg/m^2). Only 51 (10%) patients had waist-hip ratios below the recommended levels. At the time of interview, 223 (44%) had normal values of BP. 310 patients had already been diagnosed with hypertension, and were on treatment. Of these, 214 (69%) had BP values of 140/90 or higher. Of the 197 thought to be normotensive, 71 (36%) had BP values of 140/90 or higher.

Diabetes Self-Efficacy and Psychological Status

Among all respondents, 213 (42%) believed they were able to do the things necessary to manage their disease. More males (122, 54%) than females (91, 32.4%) believed in their ability to control diabetes.

The mean GHQ score was 14.69 (±7.8) in men and 17.89 (±7.73) in women, with scores ranging from 4 to 34. Among men, 123 (54.4%) had scores below 15, while 103 (45.6%) had scores above. For women, the corresponding figures were 106 (37.7%) and 175 (62.3%), respectively.

Determinants of Diabetes Control

On univariate analysis (Table 3), current hospitalization (OR 2.11(1.43–3.09); $P < 0.001$), previous hospitalization (OR 2.01(1.41–2.88); $P < 0.001$), absence of diagnosed hypertension (OR 1.5(1–2.2); $P = 0.032$), history of hyperglycemic symptoms (OR 2.27(1.47–3.51); $P < 0.001$), increased treatment duration (10 years or more vs. 3 years or less—OR 1.89(1.15–3.11); $P = 0.01$), diagnosis by private provider (OR 1.49(1.04–2.13); $P = 0.027$), current insulin use (OR 2.18(1.50–3.16); $P < 0.001$), non-receipt of advice for eye screening (OR 1.59(1.06–2.38); $P = 0.024$), non-adherence to dietary restrictions (OR 3.23(1.56–6.67); $P < 0.001$), and poor self-efficacy (OR 2.38(1.64–3.45); $P < 0.001$), were significantly associated with poor diabetes control (HbA1c ≥ 7.0%).

On multivariate logistic regression analysis, adjusting for age, gender and occupation group, variables significantly associated with diabetes control included history of hyperglycemic symptoms in the past year, current anti-diabetic treatment, adherence to dietary restrictions, and self-efficacy (Table 3). Self-efficacy was the single most important determinant of current diabetes control. Those who believed that they were able to take care of their diabetes were three times as likely to be in good control compared to those who did not believe so.

Self-efficacy in turn, showed significant associations with many socio-demographic, disease, treatment and personal characteristics (Table 4). On multivariate logistic regression adjusted for age and gender, respondents with more years of education (OR 2.59(1.35–5) for those completed school and above versus illiterate; $P = 0.017$), in active employment (OR 1.92(0.94–3.93); $P = 0.039$), without symptomatic hyperglycemia in the past year (OR 2.38(1.35–4.2); $P < 0.001$), on oral medication for diabetes (OR 1.8(1.02–3.18); $P < 0.001$), adhering to dietary (OR 2.38 (1.03–5.49); $P = 0.026$) and exercise plans (OR 2.46 (1.53–3.95); $P < 0.001$), receiving family support for being physically active (OR 3.73 (2.13–6.54), with a positive attitude to diabetes (OR 2.49 (1.54–4.05); $P < 0.001$) and no psychological stress (OR 2.16 (1.29–3.61); $P < 0.001$) were more likely to believe in their ability to manage diabetes.

Discussion

Our study demonstrates a strong positive association between self-efficacy and measured glycemic status, with self-efficacy being the strongest determinant of current glycemic status. This has been previously shown in other populations, including patients with other chronic diseases, as well [11, 18, 43]. Two recently published randomized controlled trials by Shi et al. in China, and Lee et al. in

Table 2 Achievement of ICMR-WHO targets for diabetes control among study participants

S. No	Target	Proportion of patients achieving the target (%)
1	HbA1c < 7%	41.4
2	BP < 130/80 mm Hg	44
3	BMI 20–23 kg/m^2	35.5
4	Waist-hip ratio <0.90 (men) and <0.85 (women)	10

BMI body mass index, *BP* blood pressure, *HbA1c* glycated haemoglobin, *ICMR* Indian Council of Medical Research, *WHO* World Health Organization

Table 3 Factors associated with measured diabetes control status (as determined by HbA1c) in study participants on univariate and multivariate analysis

S. No	Variable	Cases ($N = 210$)/controls ($N = 297$)	Univariate analysis		Multivariate analysis	
			P	Odds ratio (95% CI)	*P*	Odds ratio (95% CI)
Disease characteristics						
1	Hospital status—current					
	Out-patient	155/170	<0.001	2.11 (1.43–3.09)	NS	
	In-patient	55/127		1		
2	Hospitalised last year					
	No	124/124	<0.001	2.01 (1.41–2.88)	NS	
	Yes	86/173		1		
3	Hypertension					
	No	70/127	0.032	0.67 (0.46–0.97)	NS	
	Yes	140/170		1		
4	Episodes of hyperglycemic symptoms last year					
	Zero	174/202	<0.001	2.27 (1.47–3.51)	0.012	1.83 (1.15–2.93)
	One or more	36/95		1		1
Treatment details						
5	Treatment duration					
	≤3 years	98/107	0.010	1.89 (1.15–3.11)	NS	
	3–10 years	79/122		1.33 (0.81–2.21)		
	≥10 years	33/68		1		
6	Diagnosis by					
	Private practitioner/hospital	100/171	0.027	0.67 (0.47–0.96)	NS	
	Government hospital	110/126		1		
7	Current treatment					
	Oral agent(s)	146/152	<0.001	2.18 (1.50–3.16)	0.007	1.77 (1.17–2.66)
	Insulin alone or in combination	64/145		1		1
8	Advice for eye screening					
	Never	48/95	0.024	0.63 (0.42–0.94)	NS	
	At least once	162/202		1		
Patient characteristics						
9	Follow meal plan					
	Less than half the time	10/41	0.001	0.31 (0.15–0.64)	0.009	0.37 (0.17–0.78)
	Mostly/always	200/256		1		1
10	Self-efficacy					
	Poor	96/198	<0.001	0.42 (0.29–0.61)	<0.001	0.34 (0.22–0.52)
	Good	114/99		1		1

Hong Kong, testing interventions to improve self-efficacy for diabetes have also reported improvement in glycemic control with increased self-efficacy [22, 38].

Other factors that affected current glycemic control were absence of hyperglycemic symptoms in the past year and treatment with oral agents. Patients with long-standing disease were more likely to have had hyperglycemic symptoms and be in poor glycemic control at the time of interview. Symptomatic hyperglycemia in the past year and current insulin use were significantly associated with poor glycemic control. As these two are indicators for previous poor control, this is expected. This may also reflect provider and patient issues peculiar to insulin use. Patients, especially those with lower levels of literacy, need support and education in order to take insulin in the proper dosage at the appropriate times, and this is often lacking. Physician reluctance to prescribe insulin till patients progress to extreme poor control has also been highlighted by several researchers [7, 32].

Table 4 Factors associated with self-efficacy beliefs in study participants on univariate and multivariate analysis

S. No	Variables	Cases($N = 213$)/controls ($N = 294$)	Univariate analysis		Multivariate analysis	
			P	Odds ratio (95% CI)	*P*	Odds ratio (95% CI)
Socio-demographic characteristics						
1	Gender					
	Male	122/104	<0.001	2.45 (1.71–3.52)	NS	
	Female	91/190		1		
2	Marital status					
	Married	191/245	0.042	1.74 (1.01–2.97)	NS	
	Widowed/unmarried	22/49		1		
3	Annual household income					
	>50,000	97/100	0.009	1.62 (1.13–2.33)	NS	
	≤50,000	116/194		1		
4	Literacy status					
	Completed school and above	113/68	<0.001	4.58 (2.94–7.14)	0.017	2.59 (1.35–5)
	Some schooling	51/91		1.54 (0.96–2.48)		1.6 (1.51–1.71)
	Illiterate	49/135		1		1
5	Occupation					
	Employed	102/67	<0.001	1.59 (0.95–2.67)	0.039	1.92 (0.94–3.93)
	Housewife	67/181		0.39 (0.24–0.64)		0.67 (0.2–2.26)
	Retired/unemployed	44/46		1		1
6	Treatment funding					
	Own funds	124/102	<0.001	2.63 (1.83–3.77)	NS	
	Family	89/192		1		
Disease characteristics						
7	Eye problems					
	No	71/57	<0.001	2.08 (1.39–3.12)	NS	
	Yes	142/237		1		
8	Kidney problems					
	No	184/232	0.03	1.7 (1.05–2.75)	NS	
	Yes	29/62		1		
9	Hospital status—current					
	Out-patient	155/170	0.001	1.95 (1.33–2.85)	NS	
	In-patient	58/124				
10	Hospitalised last year					
	No	127/121	<0.001	2.11 (1.48–3.02)	NS	
	Yes	86/173		1		
11	Episodes of hyperglycemic symptoms last year					
	Zero	179/197	<0.001	2.59 (1.67–4.03)	0.003	2.38 (1.35–4.2)
	One or more	34/97		1		1
Treatment details						
12	Diagnosis by					
	Private practitioner/hospital	114/122	0.007	1.62 (1.14–2.32)	NS	
	Government hospital	99/172		1		
13	Current treatment					
	Oral agent(s)	151/147	<0.001	2.43 (1.68–3.53)	0.041	1.8 (1.02–3.18)
	Insulin alone or in combination	62/147		1		1
14	Measured diabetes control					
	Controlled	162/171	<0.001	2.28 (1.55–3.38)	0.001	2.47 (1.48–4.13)
	Not controlled	51/123				1

Table 4 continued

S. No	Variables	Cases($N = 213$)/controls ($N = 294$)	Univariate analysis		Multivariate analysis	
			P	Odds ratio (95% CI)	*P*	Odds ratio (95% CI)
15	Advice for foot care					
	Yes	112/110	0.001	1.86 (1.3–2.65)	NS	
	No	101/184		1		
Patient characteristics						
16	Follow meal plan					
	Mostly/always	199/257	0.026	2.05 (1.08–3.89)	0.043	2.38 (1.03–5.49)
	Less than half the time	14/37		1		1
17	Follow exercise plan					
	Mostly/always	143/119	<0.001	3 (2.08–4.34)	<0.001	2.46 (1.53–3.95)
	Less than half the time	70/175		1		1
18	Be physically active					
	Mostly/always	152/135	<0.001	2.94 (2.02–4.27)	NS	
	Less than half the time	61/159		1		
19	Family help for physical activity					
	Yes	72/66	0.005	1.76 (1.19–2.62)	<0.001	3.73 (2.13–6.54)
	No	141/228		1		1
20	Family help for foot care					
	Yes	70/63		1.8 (1.2–2.68)	NS	
	No	143/231	0.004	1		
21	Family help for testing					
	Yes	149/241	0.002	0.51 (0.34–0.78)	NS	
	No	64/53		1		
22	Diabetes knowledge					
	Fair	114/87	<0.001	2.74 (1.9–3.96)	NS	
	Poor	99/207		1		
23	Knowledge of diabetes complications					
	Fair	136/145	0.001	1.82 (1.27–2.6)	NS	
	Poor	77/149		1		
24	Understanding of diabetes care					
	Fair	104/87	<0.001	2.27 (1.57–3.28)	NS	
	Poor	109/207		1		
25	Attitude towards diabetes					
	Positive	144/83	<0.001	5.31 (3.62–7.78)	<0.001	2.49 (1.54–4.05)
	Negative	69/211				1
26	GHQ score					
	No distress	142/87	<0.001	4.76 (3.26–6.94)	0.004	2.16 (1.29–3.61)
	Distress	71/207				1

GHQ General Health Questionnaire

Adherence to dietary restrictions and diet plans was also related to improved diabetes control. Similar findings were reported by Howteerakul et al. [13] who reported that adherence to diet control and exercise were significantly associated with glycemic control. Another study by Matsushita et al. [25] found that patients who were able to estimate their energy intake reasonably well had better glycemic control.

Self-efficacy itself was influenced by a number of psychosocial inputs including educational status, employment, adherence to medical advice especially for diet and physical activity, availability of family support, and positive mental attitudes. This correlates well with previous literature showing literacy and health literacy specifically, psychological status, family and social support can influence self-efficacy beliefs, self-management behaviours, and

achievement of glycemic control as well [1, 8, 19, 21, 23, 26, 30, 36, 37, 39].

These observations from cross-sectional data need to be further validated in longitudinal studies in India with interventions targeted towards improving patients' self-efficacy, as undertaken elsewhere. The relationships between patients' self-efficacy beliefs, self-management practices and diabetes control have not been previously examined in the Indian context, and this study provides valuable insights into these relationships.

Conclusions/Recommendations

Our study suggests that improving patients' self-efficacy beliefs with reference to diabetes management may be important to achieving clinical control of disease, and has implications on how health care is organized in the hospital setting. It appears that health care delivery inputs, patients' personal characteristics including education and attitude, and family support for care are complexly processed to determine self-efficacy, which ultimately influences disease outcomes. Disease management interventions which focus on providing patients with the confidence for self-management, thereby improving self-efficacy, may therefore lead to better patient outcomes, as well as greater patient satisfaction. This will require better organization of care at the institutional level, as well as greater interface with patients and families to provide the necessary skills and support to enhance self-management.

References

1. Aljasem, L. I., Peyrot, M., Wissow, L., & Rubin, R. R. (2001). The impact of barriers and self-efficacy on self-care behaviors in type 2 diabetes. *The Diabetes Educator, 27*(3), 393–404.
2. WHO Expert Consultation. (2004). Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. *Lancet, 363*(9403), 157–163. doi:10.1016/S0140-6736(03)15268-3.
3. Bandura, A. (1989). Human agency in social cognitive theory. *The American Psychologist, 44*(9), 1175–1184.
4. Benoit, S. R., Fleming, R., Philis-Tsimikas, A., & Ji, M. (2005). Predictors of glycemic control among patients with type 2 diabetes: A longitudinal study. *BMC Public Health, 5*, 36. doi:10.1186/1471-2458-5-36.
5. Bjork, S., Kapur, A., King, H., Nair, J., & Ramachandran, A. (2003). Global policy: Aspects of diabetes in India. *Health Policy, 66*(1), 61–72. doi:S0168851003000447[pii].
6. Chobanian, A. V., Bakris, G. L., Black, H. R., et al. (2003). The seventh report of the joint national committee on prevention, detection, evaluation, and treatment of high blood pressure: The JNC 7 report. *The Journal of the American Medical Association, 289*(19), 2560–2572. doi:10.1001/jama.289.19.2560.
7. Cook, C. B., Castro, J. C., Schmidt, R. E., et al. (2007). Diabetes care in hospitalized noncritically ill patients: More evidence for clinical inertia and negative therapeutic momentum. *Journal of Hospital Medicine, 2*(4), 203–211. doi:10.1002/jhm.188.
8. DiMatteo, M. R. (2004). Social support and patient adherence to medical treatment: A meta-analysis. *Health Psychology, 23*(2), 207–218. doi:10.1037/0278-6133.23.2.207.
9. Fitzgerald, J. T., Davis, W. K., Connell, C. M., Hess, G. E., Funnell, M. M., & Hiss, R. G. (1996). Development and validation of the Diabetes Care Profile. *Evaluation and the Health Professions, 19*(2), 208–230.
10. Fox, K. M., Gerber Pharmd, R. A., Bolinder, B., Chen, J., & Kumar, S. (2006). Prevalence of inadequate glycemic control among patients with type 2 diabetes in the United Kingdom general practice research database: A series of retrospective analyses of data from 1998 through 2002. *Clinical Therapeutics, 28*(3), 388–395. doi:10.1016/j.clinthera.2006.03.005.
11. Grace, S. L., Barry-Bianchi, S., Stewart, D. E., Rukholm, E., & Nolan, R. P. (2007). Physical activity behavior, motivational readiness and self-efficacy among Ontarians with cardiovascular disease and diabetes. *Journal of Behavioral Medicine, 30*(1), 21–29. doi:10.1007/s10865-006-9080-5.
12. Heisler, M., Smith, D. M., Hayward, R. A., Krein, S. L., & Kerr, E. A. (2003). How well do patients' assessments of their diabetes self-management correlate with actual glycemic control and receipt of recommended diabetes services? *Diabetes Care, 26*(3), 738–743.
13. Howteerakul, N., Suwannapong, N., Rittichu, C., & Rawdaree, P. (2007). Adherence to regimens and glycemic control of patients with type 2 diabetes attending a tertiary hospital clinic. *Asia Pacific Journal of Public Health, 19*(1), 43–49.
14. Hurley, A. C., & Shea, C. A. (1992). Self-efficacy: strategy for enhancing diabetes self-care. *The Diabetes Educator, 18*(2), 146–150.
15. MR, I. C. (2005). *Guidelines for management of type 2 diabetes*. New Delhi, India: Indian Council for Medical Research.
16. IDF. (2009). *IDF diabetes atlas* (4th ed.). Brussels, Belgium: International Diabetes Federation.
17. Jacob, K. S., Bhugra, D., & Mann, A. H. (1997). The validation of the 12-item General Health Questionnaire among ethnic Indian women living in the United Kingdom. *Psychological Medicine, 27*(5), 1215–1217.
18. Johnston-Brooks, C. H., Lewis, M. A., & Garg, S. (2002). Self-efficacy impacts self-care and HbA1c in young adults with type I diabetes. *Psychosomatic Medicine, 64*(1), 43–51.
19. King, D. K., Glasgow, R. E., Toobert, D. J., et al. (2010). Self-efficacy, problem solving, and social-environmental support are associated with diabetes self-management behaviors. *Diabetes Care, 33*(4), 751–753. doi:dc09-1746[pii]10.2337/dc09-1746.
20. Kosachunhanun, N., Benjasuratwong, Y., Mongkolsomlit, S., et al. (2006). Thailand diabetes registry project: Glycemic control in Thai type 2 diabetes and its relation to hypoglycemic agent usage. *Journal of the Medical Association of Thailand, 89*(Suppl 1), S66–S71.
21. Lange, L. J., & Piette, J. D. (2005). Perceived health status and perceived diabetes control: Psychological indicators and accuracy. *Journal of Psychosomatic Research, 58*(2), 129–137. doi:10.1016/j.jpsychores.2004.08.004.
22. Lee, A., Siu, C. F., Leung, K. T., Lau, L. C., Chan, C. C., & Wong, K. K. (2011). General practice and social service partnership for better clinical outcomes, patient self efficacy and lifestyle behaviours of diabetic care: Randomised control trial of a chronic care model. *Postgraduate Medical Journal*. doi:10.1136/pgmj.2011.118885.
23. Lerman, I., Lozano, L., Villa, A. R., et al. (2004). Psychosocial factors associated with poor diabetes self-care management in a specialized center in Mexico City. *Biomedicine and Pharmacotherapy, 58*(10), 566–570. doi:10.1016/j.biopha.2004.09.003.

24. Mahmood, K., & Aamir, A. H. (2005). Glycemic control status in patients with type-2 diabetes. *Journal of the College of Physicians and Surgeons—Pakistan, 15*(6), 323–325.
25. Matsushita, Y., Yokoyama, T., Homma, T., Tanaka, H., & Kawahara, K. (2005). Relationship between the ability to recognize energy intake and expenditure, and blood sugar control in type 2 diabetes mellitus patients. *Diabetes Research and Clinical Practice, 67*(3), 220–226. doi:10.1016/j.diabres.2004.07.019.
26. Mishali, M., Omer, H., & Heymann, A. D. (2011). The importance of measuring self-efficacy in patients with diabetes. *Family Practice, 28*(1), 82–87. doi:cmq086[pii]10.1093/fampra/cmq086.
27. Misra, A., Vikram, N. K., Gupta, R., Pandey, R. M., Wasir, J. S., & Gupta, V. P. (2006). Waist circumference cutoff points and action levels for Asian Indians for identification of abdominal obesity. *International Journal of Obesity (Lond), 30*(1), 106–111. doi:0803111[pii]10.1038/sj.ijo.0803111.
28. Nagpal, J., & Bhartia, A. (2006). Quality of diabetes care in the middle- and high-income group populace: The Delhi Diabetes Community (DEDICOM) survey. *Diabetes Care, 29*(11), 2341–2348. doi:10.2337/dc06-0783.
29. Nichols, G. A., Hillier, T. A., Javor, K., & Brown, J. B. (2000). Predictors of glycemic control in insulin-using adults with type 2 diabetes. *Diabetes Care, 23*(3), 273–277.
30. Osborn, C. Y., Bains, S. S., & Egede, L. E. (2010). Health literacy, diabetes self-care, and glycemic control in adults with type 2 diabetes. *Diabetes Technology and Therapeutics, 12*(11), 913–919. doi:10.1089/dia.2010.0058.
31. Osborn, C. Y., Cavanaugh, K., Wallston, K. A., & Rothman, R. L. (2010). Self-efficacy links health literacy and numeracy to glycemic control. *Journal of Health Communication, 15*(Suppl 2), 146–158. doi:10.1080/10810730.2010.499980.
32. Puder, J. J., & Keller, U. (2003). Quality of diabetes care: problem of patient or doctor adherence? *Swiss Medical Weekly, 133*(39–40), 530–534.
33. Raheja, B. S., Kapur, A., Bhoraskar, A., et al. (2001). DiabCare Asia—India study: Diabetes care in India—current status. *The Journal of the Association of Physicians of India, 49*, 717–722.
34. Rayappa, P. H., Raju, K. N. M., Kapur, A., Bjork, S., Sylvest, C., & Kumar, K. M. D. (1999). The impact of socio-economic factors on diabetes care. *International Journal of Diabetes in Developing Countries, 19*, 8–16.
35. Resnick, H. E., Foster, G. L., Bardsley, J., & Ratner, R. E. (2006). Achievement of American Diabetes Association clinical practice recommendations among U.S. adults with diabetes, 1999–2002: The National Health and Nutrition Examination Survey. *Diabetes Care, 29*(3), 531–537.
36. Rosland, A. M., Kieffer, E., Israel, B., et al. (2008). When is social support important? The association of family support and professional support with specific diabetes self-management behaviors. *Journal of General Internal Medicine, 23*(12), 1992–1999. doi:10.1007/s11606-008-0814-7.
37. Schillinger, D., Grumbach, K., Piette, J., et al. (2002). Association of health literacy with diabetes outcomes. *The Journal of the American Medical Association, 288*(4), 475–482.
38. Shi, Q., Ostwald, S. K., & Wang, S. (2010). Improving glycaemic control self-efficacy and glycaemic control behaviour in Chinese patients with type 2 diabetes mellitus: randomised controlled trial. *Journal of Clinical Nursing, 19*(3–4), 398–404. doi:10.1111/j.1365-2702.2009.03040.x.
39. Trief, P. M., Morin, P. C., Izquierdo, R., et al. (2006). Depression and glycemic control in elderly ethnically diverse patients with diabetes: the IDEATel project. *Diabetes Care, 29*(4), 830–835.
40. Venkataraman, K., Kannan, A. T., & Mohan, V. (2009). Challenges in diabetes management with particular reference to India. *International Journal of Diabetes in Developing Countries, 29*(3), 103–109. doi:10.4103/0973-3930.54286.
41. WHO. (1999). *Definition and diagnosis of diabetes mellitus and intermediate hyperglycemia: Report of a WHO/IDF consultation*. Geneva, Switzerland: World Health Organization.
42. WHO. (2002). *Diet, nutrition and the prevention of chronic diseases. Joint WHO/FAO Expert Consultation on Diet, Nutrition and the Prevention of Chronic Diseases*. Geneva, Switzerland: World Health Organization.
43. Wynn Nyunt, S., Howteerakul, N., Suwannapong, N., & Rajatanun, T. (2010). Self-efficacy, self-care behaviors and glycemic control among type-2 diabetes patients attending two private clinics in Yangon, Myanmar. *The Southeast Asian Journal of Tropical Medicine and Public Health, 41*(4), 943–951.